Final

Corrective Action Work Plan

For

Interim Cleanup Action

Landfill 4/Demolition Area 1

Camp Bonneville Military Reservation, WA

Prepared for

Department of the Army
Atlanta Field Office
U.S. Army BRAC Headquarters
1347 Thorne Avenue SW
Building 243
Ft. McPherson, GA 30330-1062

Prepared by

TETRA TECH, INC.
800 Oak Ridge Turnpike, Suite A-600
Oak Ridge, TN 37830

April 2004

TABLE OF CONTENTS

This Page Intentionally Left Blank

ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society for Testing and Materials
BCT	BRAC Cleanup Team
bgs	below ground surface
BIP	blown-in-place
BRAC	Base Realignment and Closure
CAIS	Chemical Agent Identification Sets
CAWP	Corrective Action Work Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CKPS	Contaminants known to be present at the Site
CLARC	Cleanup Levels and Risk Calculations
COPC	Chemical of Potential Concern
CWM	Chemical Warfare Materiel
DGPS	differential global positioning systems
DNS	determination of nonsignificance
DOC	Dissolved Organic Carbon
DoD	Department of Defense
DOE	Washington State Department of Ecology
DS/Scoping	determination of significance/scoping notice
EE/CA	Engineering Evaluation/Cost Analysis
EIS	environmental impact statement
EO	Enforcement Order
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
ESI	Expanded Site Investigation
ESQ	Environmental Safety and Quality
EZ	exclusion zone
GFL	Geophysics Field Lead
GIS	Geographic Information System
GTM	Geophysics Task Manager
HARC	historic, archaeological, and cultural
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
IAW	in accordance with
IDW	investigation derived waste
LRA	Local Redevelopment Authority
LUMP	Land Use Management Plan
MC	munitions components
MD	munitions debris

MEC	Munitions and explosives of concern
MPM	most probable munition
MTCA	Washington State Model Toxics Control Act
NCP	National Contingency Plan
NEW	net explosive weight
OB/OD	open burn/open detonation
OSHA	Occupational Safety and Health Administration
PMC	Construction Project Manager
PMM	Project Manager for MEC Operations
PRG	Preliminary Remediation Goal
QC	Quality Control
RAB	Restoration Advisory Board
RBC	Risk Based Concentrations
SAP	Sampling and Analysis Plan
SEPA	State Environmental Policy Act
SOP	Standard Operating Procedure
SUXOS	Senior Unexploded Ordnance Supervisor
SVOC	semivolatile organic compound
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
UXO	unexploded ordnance
UXOQC	UXO Quality Control Officer
UXOSO	UXO Safety Officer
VLF	very low frequency
VOC	volatile organic compound
WAC	Washington Administrative Code

1. INTRODUCTION

This Corrective Action Work Plan (CAWP) describes the approach and proposed procedures for the environmental remedial action at Landfill 4/Demolition Area 1 (the Site) located on the Camp Bonneville Military Reservation (Camp Bonneville) near Vancouver, Washington. This CAWP represents the first of two phases of cleanup to be performed at the Site by the Army. This first phase is an interim cleanup action that will include the removal and disposal of open burn/open detonation (OB/OD) ordnance and landfill materials and specified associated contaminated soils. The second phase of the cleanup will address the groundwater contamination at the Site. Tetra Tech, Inc. is contracted to perform the first phase under Contract No. DAAD11-03-F-0102 with the Department of the Army, Atlanta Field Office.

In February 2003, the State of Washington, Department of Ecology (DOE), issued Enforcement Order (EO) 03TCPHQ-5286, pursuant to Washington Administrative Code (WAC) 173-303-646(3)(a) and 70.105 RCW, for the entire Camp Bonneville Military Reservation, including the Site. The Site is referred to as Remedial Action Unit 2C in the EO. The EO stipulated that the interim action for the Site shall be to "excavate and appropriately dispose of materials contained in and contaminated soils associated with Landfill 4/Demolition Area 1." This CAWP focuses on the first phase of the restoration of the Site, to meet the regulatory requirements to gain a no further action for the Landfill debris/soils to support the early transfer of the property to Clark County. The cleanup of the impacted groundwater is not part of this remedial action and will be performed under a separate program and contract.

Remedial activities at the Site are being completed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Contingency Plan (NCP) and the Washington State Model Toxics Control Act (MTCA). In addition, the remediation will comply with all associated applicable or relevant and appropriate requirements (ARARs) established by the State of Washington and local agencies. The goal of the remediation is to obtain all necessary regulatory approvals from relevant local, state, and Federal authorities.

The general purpose of the CAWP is to:

- Describe the proposed interim cleanup action;
- Present the cleanup levels and points of compliance for each contaminant of potential concern;
- Present the schedule for conducting the interim cleanup action;
- Describe any site restrictions or institutional controls; and

APPENDICES

LIST OF FIGURES

LIST OF TABLES

- Provide a document for public comment regarding the interim cleanup action.

The major components of the interim action are:

- Setting up the staging and debris/soil stockpile area at the location designated by Army;
- Improving the road and bridge from the former landfill to the staging and stockpile area;
- Potential munitions and explosives of concern (MEC) and related munitions components (MC) clearing of the upper debris/soil portion of the Site prior to excavation;
- Screening and disposal of MEC/MC and munitions debris (MD);
- Excavating of the remaining landfill debris/soil;
- Segregating and characterizing the landfill debris/soil for disposal purposes;
- Transporting and disposing of hazardous wastes;
- Transporting and disposing of non-hazardous wastes;
- Backfilling the excavation; and
- Implementing soil erosion control measures.

2. SITE DESCRIPTION

Camp Bonneville is a military reservation situated in the southeastern region of Clark County, Washington. The camp is located along the western foothills of the Cascade Mountain Range within unincorporated Clark County, approximately 12 miles northeast of the city of Vancouver. The smaller cities of Camas and Washougal are approximately 6 miles to the south of the reservation. Figure 2-1 presents the location of Camp Bonneville.

Camp Bonneville was established in 1909 as a drill field and rifle range for Vancouver Barracks. The 3,020 acres upon which Camp Bonneville was established were purchased by the federal government in 1919. In addition, the U.S. Army leased 840 acres of adjacent property, in two separate parcels, from the State of Washington in 1955. Of these 840 acres, 20 acres were returned to the State of Washington in 1957. The Army used Camp Bonneville for live fire of small arms, assault weapons, artillery, and field and air defense artillery between 1910 and 1995.

Camp Bonneville was selected for transfer and reuse by the U.S. Government in 1995. The community has been looking at ways to transform the surplus military property and facilities into an area that can be used by the general public. The Camp Bonneville Draft Reuse Plan (Otak, Inc. 1998) outlines the potential options for the property. Current plans for future use of the property are for recreational land use only.

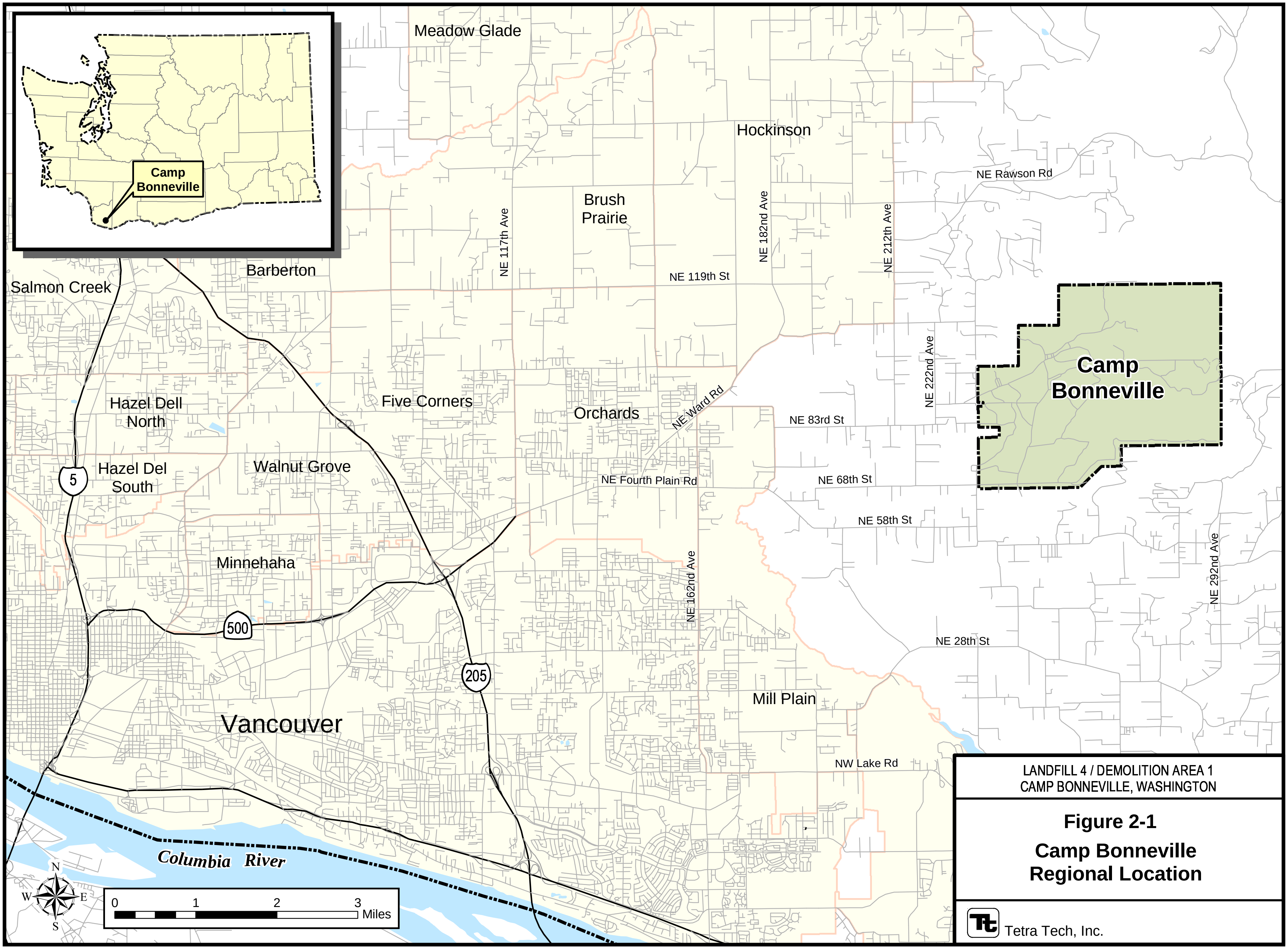
2.1 LANDFILL 4/DEMOLITION AREA 1

The Site is located in the northern part of the Camp Bonneville Military Reservation approximately one mile northeast of the Cantonment Area. Figure 2-2 presents the location of the Site. The Army proposes to use risk-based cleanup to close the Site and ultimately transfer the property to the county. The landfill reportedly received building demolition debris during the mid-1960s and later was used as an OB/OD area. The OB/OD area is, therefore, underlain by the old landfill.

In early 2003, an Expanded Site Investigation (ESI) was conducted to evaluate the potential impacts to groundwater resulting from historical landfill and OB/OD activities at the Site. It was determined that the Site was likely contributing to the contamination of the underlying groundwater with the potential of impacting the nearby Lacamas Creek.

The area of the Site is reported to be 120 by 200 feet and the depth appears to extend beyond 11 feet below ground surface (bgs). The Army has indicated that all unexploded ordnance (UXO) activities at the site were limited to the upper portion of the Landfill. Shallow soils at the site are comprised primarily of silts and clays. The depth to groundwater at the site fluctuates seasonally. Based on available data, the average depth to groundwater at the site is 15 to 19 feet bgs, depending on the time of year. Groundwater flow direction at the site appears to follow the surface topography and

This Page Intentionally Left Blank



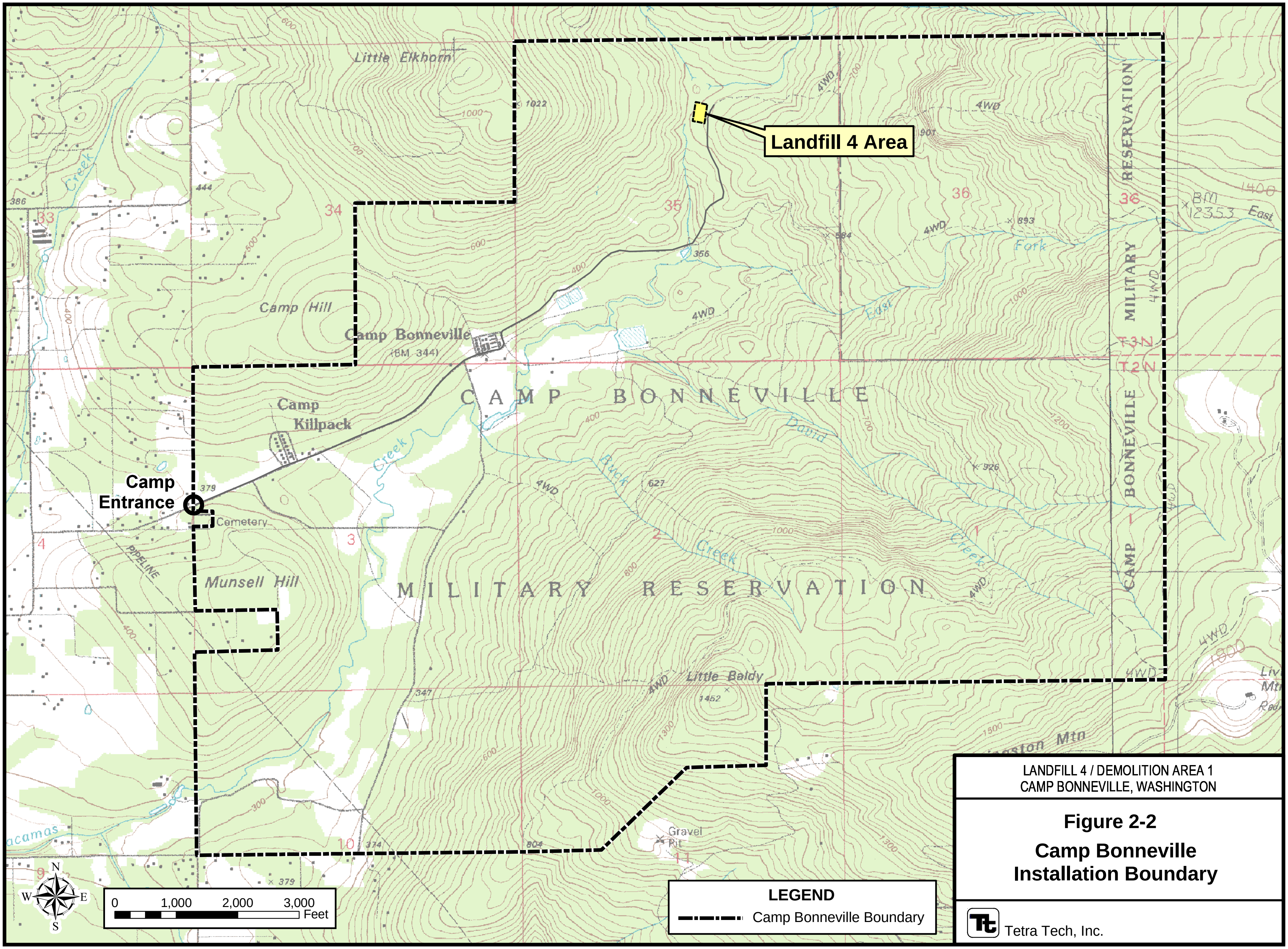
LANDFILL 4 / DEMOLITION AREA 1
CAMP BONNEVILLE, WASHINGTON

Figure 2-1
Camp Bonneville Regional Location

Tetra Tech, Inc.

X:\GIS\BONNEVILLE\VICINITY.MXD

This Page Intentionally Left Blank



LANDFILL 4 / DEMOLITION AREA 1
CAMP BONNEVILLE, WASHINGTON

Figure 2-2
Camp Bonneville Installation Boundary

Tetra Tech, Inc.

X:\GIS\BONNEVILLE\TOPO_MAP.MXD

generally flows from east to west toward the North Fork of Lacamas Creek. The fine-grained nature of the soils at the site has resulted in low hydraulic conductivities.

2.1.1 Chemical Constituents In Soil and Groundwater

Although investigations at the site have been limited to the areas adjacent to the former landfill because of concerns about UXO, the Base Realignment and Closure (BRAC) Cleanup Team (BCT) has agreed that the Chemicals of Potential Concern (COPCs) at the Landfill based on historic land use include high explosives and organic compounds, artillery propellants (including ammonium perchlorate), volatile organic compounds (VOCs), priority pollutant metals, semivolatile organic compounds (SVOCs), Total Petroleum Hydrocarbons (TPH) (gasoline, diesel and oil), and possibly pesticides and herbicides.

2.1.2 Ordnance In The Landfill

The Site has been used for the disposal of many types of MEC over the years. However, little or no accurate information is available regarding the specific types and amounts of materials destroyed at the Landfill. Research has yielded a general understanding of the types of ammunition commonly used, stored, or disposed of at Camp Bonneville during and after World War II. Table 2-1 presents a summary of ordnance items used, stored, and disposed of at Camp Bonneville. The ordnance presented in the table represents the potential MEC at Camp Bonneville. Table 2-2 presents a summary of the MEC found or known to have been disposed of at Landfill 4/Demolition Area 1. This information was obtained from the Final Archive Search Report Findings (USACE, 1997) and the Supplemental Archive Search Report (URS Greiner Woodward Clyde, 1999) for the site. In addition to the items listed in Table 2-2, car bodies, railroad ties, railroad rails, and old appliances have been found at Landfill 4/Demolition Area 1.

The historical munitions data available were reviewed, along with anecdotal information from past and present employees at Camp Bonneville, to assess the most probable munition (MPM) for the Site. The MPM for a site is the round with the greatest fragmentation distance that can reasonably be expected to exist in any particular MEC area. Based on the widespread use of large artillery projectiles on the ranges at Camp Bonneville and the discovery of a 155mm projectile at the Landfill, the 155mm projectile has been selected as the MPM for a majority of the site work. Two of the tasks outlined in this CAWP (tiered soil removal and soil screening) involve soils that have already been subjected to rigorous MEC removal procedures. For these two tasks, the MPM has been identified as a 20mm projectile. More details regarding the MPMs for the site and the rationale for their selection are provided in Section 5.0 of the CAWP.

The historical data available suggest that Chemical Warfare Materiel (CWM) is not present at the Landfill; however, Chemical Agent Identification Sets (CAIS) were utilized at Camp Bonneville and there is a remote chance that these items were disposed of at the Landfill. If CWM is encountered, the emergency response protocol described in Section 5-1 will be followed.

Table 2-1
Summary of Ordnance Items Used, Stored or Disposed of

Listing of Ordnance	
Small Arms, General	Cartridge, 81-mm, Smoke, WP, M370
Shell, Shotgun, 12 Gage	Cartridge, 81-mm, Illuminating, M301A2 and M301A1
Cartridge, 14.5-mm, Trainer-Spotter, M183A1	Cartridge, 81-mm, Illuminating, M301A3
Shell, Fixed, 37-mm, HE, MKII	Cartridge, 81-mm, SABOT, M1, 22-mm Sub-caliber Practice Cartridge M744, M745,
Shell, Fixed, HE, 37-mm, M54 with Self Destruct Tracer	M746 and M747
Shell, 37-mm, Fixed, HE, M54	Cartridge, 81-mm, Training, M68
Shot, AP, 37-mm, M74 with Tracer	Trench Mortar, HE, 3-Inch, MK I, MK II and Practice MK III
Shot, Fixed, APC, 37-mm, M59	Cartridge, 4.2-Inch, Illuminating, M335A2
Projectile, Practice, 37-mm, M55A1	Cartridge, 4.2-Inch, HE, M3A1 and M3
Cartridge, 37-mm, TP, M63 MOD 1	Mortar, 4.2-Inch, Smoke, WP, M328
Cartridge, AP-T, 40-mm, M 81	Cartridge, 4.2-Inch, Smoke, PWP or WP, M2A1 and M2
Projectile, 40-mm, HE, HE-I, Mk 2	Rocket, 2.36-Inch Anti-tank, M6A1, Practice, M7
Cartridge, 40-mm, Practice, M382	Rocket Motor, 2.75-Inch, MK40 Mod 7
Cartridge, 40-mm, Practice, M385	Rocket, HEAT, 3.5-Inch, M28
Cartridge, 40-mm, HE, M406	Rocket, Practice, 3.5-Inch, M29
Cartridge, 40-mm, Practice, M781	Rocket, HEAT, 66-mm, M72, A1, A2 and A3
Shell, 75-mm, High Explosive, M48	Rocket, Sub-caliber, 35-mm, M73
Cartridge, 75-mm, HE, M309A1 Recoilless Rifle	Missile, Aim-7E3, Aim-7F/M, Sparrow
Shell, Fixed, HE, 3-Inch, MK IX	Grenade, Fragmentation, Delay, M26A1 and M26
Shell, Fixed, 3-Inch, HE, M42 and M42A1	Grenade, Fragmentation, Delay, M33
Shell, Fixed, Practice, 3-Inch, M42B2	Grenade, Fragmentation, Delay, Mk II and Mk IIA1
Shot, Fixed, AP, 3-Inch, M79	Grenade, Hand, Training, Mk IA1
Cartridge, 105-mm, HE, M1	Rifle Grenade, Smoke, WP, M19A1
Cartridge, 105-mm, TP-T, M67	Rifle Grenade, Smoke, M22
Cartridge, 105-mm, HEAT-T, M622	Grenade, Rifle Practice, M11A2
Cartridge, 105-mm, Illuminating, M314A3	Anti-Tank Rifle Grenade, M9A1
Cartridge, 105-mm, Smoke, WP, M60, M60A1, M60A2	Rifle Grenade, Fragmentation, M17
Projectile, 155-mm, AP, M112	Grenade, Smoke, WP, M15
Projectile, 155-mm, HE, Mk I, Mk IA1	Grenade, Hand, Tear, CN, M7 and M7A1
Projectile, 155-mm, Smoke, WP, M110 and M110E1	Grenade, Smoke, M18 with fuze, M201, M201A1
Projectile, 155-mm, HE, M107	Grenade, Smoke, HC, AN-M8
Projectile, 155-mm, Illum, M118 Series	Mine, Anti-personnel, Practice, M68
Propelling Charge, 155-mm, M3 Series	Mine, Anti-Tank, M7A1
Propelling Charge, 155-mm, M4 Series	Mine, Anti-Tank, M1A1
Mortar, 60-mm, HE, M49A2	Signals, Illuminating, Ground, Parachute, Red Star, M126A1; White Star, M127A1; Green
Cartridge, 60-mm, Illuminating, M83A3, M83A2 and M83A1	Star, M195
Cartridge, 60-mm, Training, M69	Simulator, Projectile, Ground Burst, M115A2
Cartridge, 60-mm, SABOT M3, 22-mm Sub-caliber Practice Cartridge M744, M745,	Simulator, Hand Grenade, M116A1
M746 and M747	Simulator, Boobytrap, Flash, M117; Illuminating, M118; Whistling, M119
Shell, 81-mm, HE and Practice, M43A1	Chemical Agent Identification Set (CAIS): Set, Gas Identification, Detonation, M1

Note: In accordance with the text of the Archive Search Reports, this list of items may or may not include all ammunition that has been used on Camp Bonneville. The intent of the list is to provide the reader with the most likely, and in some cases the most hazardous, items that may still be present at Camp Bonneville.

Table 2-2
Summary of Ordnance-Related Items
Found/Known to Have Been Disposed of at the Landfill

Class C Fireworks
F-84 Ejection Seats
C-119 JATO Bottle
20mm Ammunition
2.75-inch Rockets
155mm Round
AIM 4 Falcon Missiles (warheads and motors)
AIM 9 Warheads
AIM 7 Sparrow Missiles
Mark 38 Rocket Motors
C4 Explosive (training)
Detonation Cord (training)
TNT (training)
Small Arms
Grenade Spoons
Rifle Grenades
Time Fuze

3. SUMMARY OF CLEANUP STANDARDS AND POINTS OF COMPLIANCE

The following section describes how Tetra Tech will evaluate the environmental condition of the site in compliance with the DOE MTCA Cleanup Regulation (WAC chapter 173-340). Indicator hazardous substances, applicable MTCA cleanup levels, points of compliance, and ARARs are defined in the following sections.

3.1 INDICATOR HAZARDOUS SUBSTANCES

Contaminants known to be present at the Site (CKPS) were identified based upon the results presented in the Landfill 4 Site Investigation Report prepared by Shannon and Wilson in 1999, and the Expanded Site Inspection Report prepared by URS in 2003. Given that contaminants detected in the groundwater underlying the Site likely originate from either the materials buried in the Landfill or the surface and near-surface ordnance detonation activities conducted at the Site, the indicator hazardous substances selected for soil include substances that have been detected in both the soil and groundwater. The selection was based upon the magnitude of results obtained during past investigations and the toxicity and persistence of the compounds under consideration. The CKPS for soil and groundwater and the selected indicator hazardous substances are presented in Sections 3.1.1 and 3.1.2, respectively. During the cleanup action, the analytical results of the indicator hazardous substances and other COPCs will be compared to MTCA soil cleanup criteria to determine when the cleanup action has reached compliance with MTCA cleanup criteria and is considered complete.

3.1.1 Soil Investigations

The CKPS in soil, the maximum observed concentration, and those contaminants selected as indicator hazardous substances for soil are presented in Table 3-1.

Table 3-1
CKPS in Soil and Those Selected as Indicator Hazardous Substances for Soil

Contaminants Known to be Present at the Site	Maximum Observed Concentration (mg/kg)	Selected as Indicator Hazardous Substances
Arsenic	6.6	
Barium	711	*
Beryllium	1.1	
Chromium	85.3	*
Copper	267	*
Nickel		

The only contaminants detected which exceed the DOE MTCA Method B screening levels for the protection of groundwater were barium, copper, and chromium. However, only total chromium levels were analyzed in the previous sampling effort and the MTCA screening value is based upon hexavalent Chromium (Cr^{+6}). Actual Cr^{+6} levels may be less than those reported. Therefore, although chromium may not warrant inclusion as an indicator hazardous substance, due to its toxicity it has been listed as such until further analyses and speciation indicate whether its inclusion is truly warranted. Arsenic, beryllium, and nickel were detected in Site soils above the MTCA Method B screening levels, however at concentrations lower than documented Clark County background concentrations for these metals. Therefore, these three analytes were not selected as indicator hazardous substances. Low levels of one or more VOCs, SVOCs, insecticides, and herbicides were also detected in some soil samples collected from the Site, but all detected concentrations were below regulatory screening criteria levels.

3.1.2 Groundwater Investigations

The CKPS in groundwater, the maximum observed concentration, and those contaminants selected as indicator hazardous substances for soil are presented in Table 3-2.

Explosives and propellants were detected in all groundwater samples collected from at the Site. The detected explosives and propellants were RDX, HMX, perchlorate, 2,4-dinotrotoluene, and 2-nitrotoluene. The maximum concentration of RDX detected in groundwater exceeds the MTCA Method B cleanup level, the U.S. Environmental Protection Agency (EPA) Region 9 Preliminary Remediation Goal (PRG) level, and the EPA Region 10 Risk Based Concentration (RBC) level. The maximum detected concentrations of perchlorate and 2,4-dinitrotoluene exceed the EPA Region 9 PRG and the Region 10 RBC level. Based on the detected levels and the regulatory thresholds, RDX, HMX, perchlorate, and 2,4-dinotrotoluene were selected as indicator hazardous substances for the interim cleanup action.

Thirteen VOCs were detected in groundwater samples collected from the Site, of which only five exceeded regulatory screening levels. These five compounds are 1,1,1-trichloroethane, 1,1-dichloroethene, benzene, dichlorodifluoromethane, and tetrachloroethene. All five of these VOCs were selected as indicator hazardous substances.

Thirteen metals were detected in all of the groundwater samples collected from the Site, of which only five exceeded regulatory screening levels. These five compounds are arsenic, copper, iron, lead, and zinc. All five of these metals have been selected as indicator hazardous substances.

No SVOCs, TPH-Gasoline, TPH-Diesel, nitrite, cyanide, Total Organic Carbon (TOC), Dissolved Organic Carbon (DOC), or herbicides were detected in any of the groundwater samples collected from the Site.

Table 3-2
CKPS in Groundwater Selected as Indicator Hazardous Substances for Soil

Contaminants Known to be Present at the Site	Maximum Observed Concentration (µg/L)	Selected as Indicator Hazardous Substances
Explosives and Propellants		
2,4-dinitrotoluene	0.49	*
HMX	2.9	*
2-nitrotoluene	0.26	
Perchlorate Ion	251	*
RDX	120	*
Volatile Organic Compounds (VOCs)		
Acetone	4.1	
Benzene	0.7	*
Dichlorodifluoromethane	120	*
1,1-dichloroethane	33	
1,1-dichloroethene	36	*
1,1,1-trichloroethane	290	*
Trichloroethene	9.8	
Trichlorofluoroethane	0.8	
1,1,2-trichloro-1,2,2-trifluoroethane	91	
Tetrachloroethene	1.1	*
Metals		
Arsenic	2.5	*
Barium	93	
Calcium	9020	
Chromium	65	
Copper	16	*
Iron	10,400	*
Lead	12	*
Magnesium	6410	
Nickel	40	
Potassium	10,600	
Selenium	0.6	
Sodium	26,500	
Zinc	49	*

In summary, CKPS are contaminants that have been positively detected in either the soil or the groundwater at the Site and, therefore, are presumed to be present in the Landfill debris/soils. The indicator hazardous substances selected for this proposed soil interim cleanup were derived from the CKPS in both soil and groundwater. Further, because of the limitations that the MEC/MC have placed on previous investigations conducted at the Site, the BCT has developed a comprehensive list of COPCs for testing during the excavation of the Landfill. Tetra Tech will analyze the soils at the point of compliance and excavation limits for the COPCs and compare the analytical results with the approved cleanup levels. The Confirmation Sampling and Analysis Plan (SAP) includes detailed information on the analytical methods and procedures proposed to identify the presence of COPCs.

3.2 CLEANUP LEVELS AND POINTS OF COMPLIANCE

The MTCA Cleanup Regulation (WAC Chapter 173-340) defines a two-step approach for establishing cleanup requirements for individual sites. First, cleanup standards must be established, including contaminant cleanup levels and points of compliance. The selected cleanup action, or actions, must then be able to meet these cleanup standards. Cleanup levels determine the concentration at which a particular hazardous substance no longer poses an unacceptable risk to human health or the environment. Points of compliance designate the location on the site where the cleanup levels must be met. The MTCA regulation provides three options for establishing cleanup levels, Methods A, B, and C.

Use of Method A is designed for cleanups that are relatively straightforward or involve only a few hazardous substances. Method A provides tables of cleanup levels established by DOE that are deemed protective of human health. These cleanup levels were developed using the procedures in Method B and include 25 to 30 of the most common hazardous substances found in soil and groundwater at sites. This method is typically used at smaller sites that do not warrant the costs of conducting detailed site studies and site-specific risk assessments.

Method B may be used at any site and is the most common method for setting cleanup levels at sites contaminated with substances not listed under Method A. Method B cleanup levels are established using applicable state and federal laws, the risk assessment equations provided in MTCA, and other requirements specified for each medium. Method B is divided into two tiers, standard and modified. Standard Method B uses generic default assumptions to calculate cleanup levels. The DOE has pre-calculated cleanup levels using the standard Method B equations for most regulated substances. Modified Method B provides for the development of site-specific cleanup levels using chemical-specific or site-specific information to change selected default assumptions in the standard method. Sites that are remediated using Method B cleanup levels generally do not require future restrictions on the use of the property, due to the small amount of residual contamination typically left on the property.

Method C cleanup levels may be used to set soil and air cleanup levels at industrial sites, and for groundwater, surface water, and air cleanup levels, when Method A or Method B cleanup levels are lower than technically possible, or when cleanup levels are lower than area background concentrations. Like Method B, Method C is divided into two tiers, standard and modified. However, cleanup levels are based on less stringent exposure assumptions, and the lifetime cancer risk is set higher for both individual substances and for the total cancer risk caused by all substances on a site. Remediation to Method C cleanup levels assumes that risks to human health and/or the environment remain onsite subsequent to remediation, and so requires that institutional controls be placed on the property.

At the Site, Tetra Tech proposes the use of Method B cleanup levels for the following reasons:

1. Based on the review of previous investigations, not all of the contaminants previously detected at the site are listed under Method A.
2. The contaminant concentrations detected to date in soil and groundwater samples collected from the Site are relatively low. Therefore, Tetra Tech does not believe that the use of modified Method B to develop site-specific cleanup levels is currently warranted.
3. Method C is designed for use at industrial or controlled sites where contaminant pathways resulting in human health risks are limited and institutional controls can be put in place that eliminate or reduce the potential human health risks to acceptable levels. Given that proposed reuse options for the site include public access parkland, this Method represents a less desirable solution.

Once the initial results of confirmation samples have been obtained, these results will be compared to the standard Method B concentrations published by DOE in the document entitled MTCA Cleanup Levels and Risk Calculations (CLARC) Version 3.1, as revised in 2001. If this comparison indicates that site cleanup will not be achieved using standard Method B cleanup levels, additional data will be collected to support cleanup level development under modified Method B, or possibly Method C.

The Army's scope of work for the interim cleanup action and DOE's EO stipulate the Site is to be cleaned by excavation. The goal of the interim cleanup action is to remove contaminant sources to groundwater. Based on the likely operational history of the Site, contaminant sources are associated with the landfill disposals and ordnance demolition. Normal landfill construction would not result in excavation below the water table. Thus, it is unlikely that landfill debris was placed below the water table. Likewise, demolition activities occurred after landfill operations cease. Normal demolition activities were unlikely to excavate through landfill debris to the water table to destroy munitions. Excavation to remove the sources within the landfill should initially terminate once native soil is encountered in the floor of the excavation. Confirmatory samples (taken on a maximum 25-foot grid spacing with biased samples collected from locations determined by site conditions) may indicate areas of soil contamination, i.e., potential sources of groundwater contamination. Identified areas of soil contamination will be excavated to clean native soil (confirmed with sampling).

Contaminated soil below the water table is not likely to represent primary sources. The contaminants of concern in the groundwater at Landfill 4 are RDX and perchlorate. The contaminants exhibit relatively low sorption coefficients, i.e., they tend to remain in solution and not sorbed to aquifer solids. The most efficient way to remediate the sorbed components on aquifer solids is to treat (e.g., in situ biodegradation) the dissolved phase components thereby promoting further desorption and treatment.

Therefore, Tetra Tech proposes to excavate all of the landfilled material present onsite vertically to an estimated average depth of 15 feet or to groundwater. Tetra Tech proposes to set the no further action vertical point of compliance for soil contamination at the Site at the point at which the MTCA Method B limits for soil are met. Laterally, the no further action point of compliance for soil contamination at the Site will be the point at which MTCA Method B limits for soil are met. If soil contamination extends into the saturated zone, the results of the confirmation sampling will be discussed with DOE to identify a path forward for further remedial action. No groundwater remedial action shall be included in this cleanup effort.

Table 3-3 presents the MTCA Method B soil cleanup levels for the selected indicator hazardous substances. A table similar to Table 3-3 will be developed for all COPCs detected during the confirmation sampling.

Table 3-3
Cleanup Criteria for Soil

Selected Indicator Hazardous Substances	MTCA Method B Soil Cleanup Level[a] (mg/kg)	EPA Region 9 PRG[b] (mg/kg)
Explosives and Propellants		
2,4-dinitrotoluene	0.5	120
Perchlorate Ion	0.5	7.8
HMX	3.2	3,100
RDX	0.5	4.4
Volatile Organic Compounds (VOCs)		
Benzene	0.05	0.6
Dichlorodifuoromethane	6.4	94
1,1-dichloroethene	0.003	120
1,1,1-trichloroethane	1.584	1,200
Tetrachloroethene	0.053	1.5
Metals		
Arsenic	6.0	22
Barium	450	5,400
Chromium III	576	100,000
Chromium VI	27	30
Copper	267	3,100
Iron	36,100	23,000
Lead	17	400
Zinc	96	23,000

Notes: a – Washington State Department of Ecology Model Toxics Control Act Cleanup Regulation, Washington Administrative Code Chapter 173-340, Method B Cleanup levels derived using DOE's MTCASGL10 workbook for the protection of groundwater.
b – From EPA Region 9 website: http://www.epa.gov/region09/waste/sfund/prg/files/02table.pdf.

3.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

The EPA has defined ARARs as those promulgated regulations that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. EPA also states that non-promulgated advisories and guidance documents issued by federal or state governments do not have the status of potential ARARs, but may be used to determine the level of cleanup necessary to protect human health and the environment. For a regulation to be applicable, it must satisfy all jurisdictional prerequisites of the requirement.

DOE has defined the term "applicable state and federal laws" as including those legally applicable requirements and requirements that DOE determines are relevant and appropriate requirements. Legally applicable requirements include those cleanup standards, standards of control, and other environmental protection requirements, criteria, or limitations adopted under state or federal law that specifically address a hazardous substance, cleanup action, location or other circumstances at the Site. Promulgated requirements are those laws and regulations that are of general applicability and are legally enforceable. Relevant and appropriate requirements include those cleanup standards, standards of control, and other environmental requirements, criteria, or limitations established under state or federal law that, while not legally applicable to the hazardous substance, cleanup action, location, or other circumstance at a site, address problems or situations sufficiently similar to those encountered at the Site that their use is well suited to the particular site.

Table 3-4 provides a list of the federal, state, and local statutes and regulations that could serve as potential ARARs for the cleanup action at the Site. The table is arranged as follows: in the first column, the appropriate federal or state statute is listed, with subsequent listings of the statute given as abbreviations; in the second and third columns, the corresponding regulations are cited as provided by regulatory agencies, and a brief description is given. The final column of the table presents a rationale for the selection of the ARAR in regard to the activities to be performed during the Cleanup Action.

Table 3-4
Preliminary Identification of Federal, State, and Local
Applicable or Relevant and Appropriate Requirements

Federal Statute	Regulation	Description	Preliminary Rationale for Selection
RCRA[a]	40 CFR Chapter I Subchapter D Part 148 and Subchapter I Parts 260 through 282	Establishes regulations for the identification, management, and disposal of hazardous materials and hazardous wastes	SELECTED – will regulate the management and disposal of investigation derived waste (IDW) and materials generated during landfill excavation
HMTA[b]	49 CFR Chapter I Parts 171 through 179	Establishes regulations regarding the transportation of hazardous materials and hazardous wastes	SELECTED – will regulate the transportation of landfill material and IDW for disposal
CWA[c]	40 CFR Chapter I Subchapter D, Parts 125 through 131	Establishes regulations for the protection of the surface waters of the United States	SELECTED – will regulate the control of surface discharges during excavation
CAA[d]	40 CFR Chapter I Subchapter C Part 63	National Emission Standards for Hazardous Air Pollutants	SELECTED – will regulate the control of air emissions during soil excavation
OSHA[e]	29 CFR Chapter 1910 and 1926	Establishes regulations to protect workers health and safety	SELECTED – will regulate the control of physical, chemical, and biological hazards to human health during the cleanup action
State Statute	**Regulation**	**Description**	**Preliminary Rationale for Selection**
WAC[f]	Chapter 173-340	Model Toxics Control Act (MTCA) establishing rules for contaminated site cleanup and soil and groundwater cleanup levels	SELECTED – MTCA will regulate site cleanup and the selection of cleanup levels
RCW[g]	Chapter 70.94.040	Law prohibiting any activity that causes air pollution	SELECTED – will regulate the control of air emissions during soil excavation
RCW	Chapter 70.105	State Hazardous Waste Statute creating a hazardous waste management system	SELECTED – will regulate the management and disposal of IDW and landfill materials generated during the removal action

Table 3-4
(continued)

State Statute	Regulation	Description	Preliminary Rationale for Selection
WAC	Chapter 173-303	State Dangerous Waste Regulations	SELECTED – will regulate the characterization, management, and disposal of IDW and landfill materials
RCW	Chapter 70.107	State Noise Control Law	SELECTED – will apply during cleanup activities
RCW	Chapter 49.17	Laws established to protect worker's health and safety	SELECTED – will apply during the cleanup action; designed to control physical, chemical, and biological hazards to human health
RCW	Chapter 296	Regulations established to protect worker's health and safety	SELECTED – will regulate the control of physical, chemical, and biological hazards to human health during the cleanup action
WAC	Chapter 173-400	Establishes standards for fugitive dust and specific VOC source emissions	SELECTED –will regulate the control of fugitive dust emissions during soil excavation
Local Statute	**Regulation**	**Description**	**Preliminary Rationale for Selection**
CCC[h]	Title 9 Chapter 9.14	Establishes Clark County's noise control ordinance	SELECTED – will apply during cleanup activities
CCC	Title 10 Chapter 10.08A	Establishes vehicle load limits and oversize load permit requirements for Clark County	SELECTED – will apply to the transportation of IDW, excavated materials, and fill materials during cleanup activities
CCC	Title 20	Establishes Clark County's State Environmental Policy Act Policies and Procedures	SELECTED – will apply based on the selected remedial action
CCC	Title 24 Chapter 24.12	Prescribes standards for the storage, transportation and disposal of wastes within Clark County	SELECTED – will apply to the transportation of IDW, excavated materials, and fill materials during cleanup activities

Notes:
a – Resource Conservation and Recovery Act.
b – Hazardous Materials Transportation Act.
c – Clean Water Act.
d – Clean Air Act.
e – Occupational Safety and Health Administration.
f – Washington Administrative Code.
g – Revised Code of Washington.
h – Clark County Code.

4. PROPOSED INTERIM ACTION

The proposed interim action for the Site is the excavation and disposal of the landfilled material and associated soil contaminated above MTCA Method B cleanup levels. This interim action does not include the groundwater. Because of the topography, the available working area around the former landfill itself is limited. Sorting, stockpiling, and profiling of the excavated materials from the former landfill prior to transportation/disposal will take place a short distance away from the landfill. A relatively flat clearing located adjacent to the Camp Bonneville cantonment area is proposed for the sorting, stockpiling, and profiling area. The proposed layout of the Site is presented in Figure 4-1. Prior to the excavation of the former landfill, both site preparation and ordnance-related support will be required. The following section provides a general summary of the activities associated with the proposed interim action.

4.1 SITE PREPARATION

Prior to the excavation of the Landfill, several site preparation activities will be required. The activities are expected to include: the preparation of the soil stockpile areas, the equipment staging area, and the equipment decontamination station; improvements to the existing roadway and bridge; and the preparation of the Landfill buffer and work area. Because of the long history of ordnance use at Camp Bonneville, site preparation tasks will require inclusion of MEC/MC avoidance to protect construction workers performing intrusive tasks.

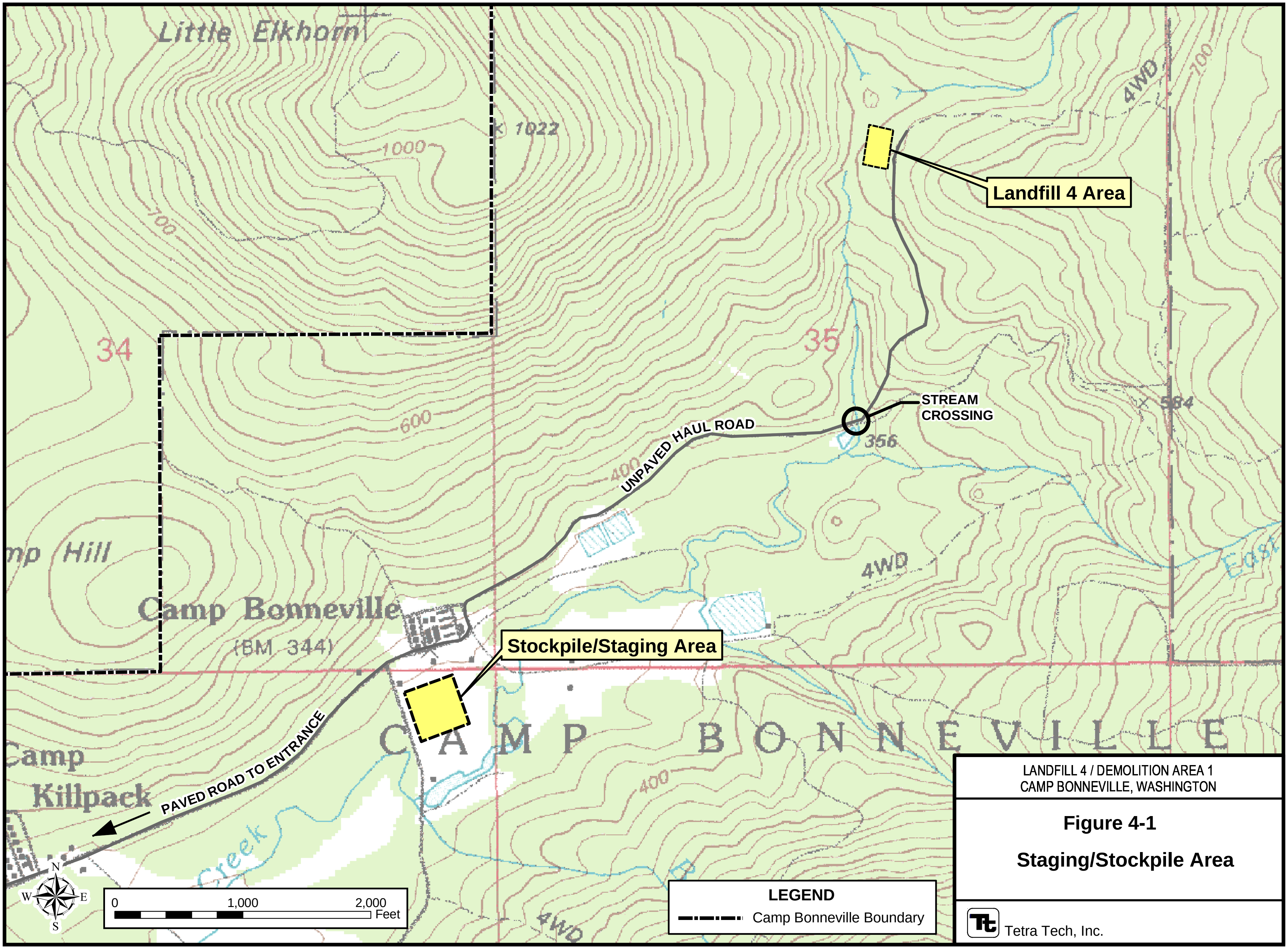
4.1.1 Soil Stockpile Areas, Equipment Staging Area, and Equipment Decontamination Station

Three areas will be required to provide space for ancillary activities such as equipment and materials storage, stockpiling of excavated soil, soil screening to remove MEC/MC, and equipment decontamination. The first area of approximately 2 acres will be used for screening, sorting, stockpiling, and profiling of the materials excavated from the former landfill. The second area of approximately one acre will be used for equipment staging and decontamination. The last area, also of approximately one acre, will be used for the stockpiling of backfill and other construction material.

4.1.2 Road and Stream Crossing Improvements

The road accessing the Site was not designed to handle the traffic that the proposed interim action will require. Therefore, the roadway that accesses the Site and the bridge that crosses Lacamas Creek require improvement. This activity will involve the grading, widening, and general improvement of the roadway and stream crossing at the project site to support the extensive truck traffic during the interim action.

This Page Intentionally Left Blank



LANDFILL 4 / DEMOLITION AREA 1
CAMP BONNEVILLE, WASHINGTON

Figure 4-1

Staging/Stockpile Area

4.1.3 Landfill Buffer and Work Area

A buffer around the Landfill for equipment to maneuver and a small working area adjacent to the Landfill to load and maneuver trucks will also be required. Both the buffer around the Landfill and the working area adjacent to the Landfill will be cleared of vegetation. The working area adjacent to the Landfill will be improved as necessary. Because of its proximity to the Landfill, this task will require inclusion of surface clearance and MEC/MC avoidance in specific areas to protect construction workers performing intrusive tasks such as earthwork.

4.2 DESCRIPTION OF ORDNANCE-RELATED SUPPORT ACTIONS

The ordnance support actions for this project consist of several inter-related tasks designed to ensure the safety of construction workers and other site personnel involved in the excavation of the Landfill. The physical activities described in this section of the CAWP will be supplemented with targeted training and rigorously enforced safety precautions to provide a comprehensive system for safe, effective implementation of the soil removal action described in the previous section. Ordnance-related support actions are briefly described in the following paragraphs. Specific details of the methodology for each task are presented in Section 5.

4.2.1 Surficial MEC/MC Clearance/Brush Removal

A surface clearance will be performed at the Landfill prior to the beginning of other planned activities. The purpose of this activity will be twofold: (1) to identify and remove MEC/MC that may pose a hazard to site personnel, and (2) to remove metallic debris that may interfere with planned geophysical activities in support of MEC/MC removal. During the surface clearance, brush and vegetation that may interfere with future geophysical survey activities and visual observation of construction activities will be removed. This will improve the ability of UXO personnel to provide effective MEC/MC avoidance and removal. Surface clearance will also be performed in other areas where intrusive work such as earthwork is planned.

4.2.2 Removal of MEC/MC in Shallow Landfill Soils

The techniques used by the Army for disposal of MEC at the Landfill may have resulted in MC in the shallow soils of the Landfill (approximately 0 - 4 feet). Removal of this soil for future disposal will require much more extensive MEC/MC avoidance efforts (in the form of MEC/MC removal) than those required for soils located deeper in the Landfill. The purpose of this task is to safely and effectively remove the MEC/MC from the shallow landfill soils so that less labor intensive techniques may be used to evaluate and remove soils that lie deeper in the Landfill. A mag and dig technique will be coupled with tiered soil removal to allow for careful examination of the shallow soils and comprehensive removal of the MEC/MC and metallic debris present.

4.2.3 Removal of MEC/MC in Deep Landfill Soils

Once the shallow soils of the Landfill have been cleared of MEC/MC and metallic debris, this task will be implemented to clear the deeper landfill soils for safe removal. Geophysical survey techniques will be applied to locate and evaluate potential ordnance items. UXO personnel will perform intrusive investigation of metallic anomalies and identify those items that require removal prior to more conventional excavation of the remainder of the Landfill.

4.2.4 MEC Avoidance for Soil Removal Action

The MEC/MC activities described in the previous section will result in identification and removal of a very large percentage of the MEC/MC present at the Landfill; however, all detection techniques used to identify ordnance-related items have limitations based upon the design of the metal detectors employed and the composition, size, depth, and orientation of the target items. In order to ensure the safety of construction personnel performing soil removal, all activities will be observed by trained UXO personnel. These individuals will provide constant monitoring of intrusive actions to allow prompt identification and removal of MEC/MC from the work area. UXO staff will also monitor intrusive actions at areas outside the landfill.

4.2.5 Mechanical Screening of Excavated Soils for MEC/MC

Mechanical screening of the soils removed from the Landfill during the mag and dig operations will provide another opportunity to increase the effectiveness of MEC/MC removal. Soils taken from the Landfill during this phase of operations will be processed through a mechanical screen plant equipped with a magnetic bar. Both the screen and the magnet will remove small MEC/MC items that may not have been detected or observed during previous MEC/MC removal activities. The screening is a very reliable method for evaluating the results of previous avoidance actions and removing remaining items of concern from the soils prior to disposal at a regional landfill.

4.2.6 Management and Disposition of MEC/MC and Metal Waste

The final component of MEC/MC support actions will be the inspection and/or disposal of MEC/MC and MD and final disposition of the wastes. All MEC and MC must be disposed of properly. The proposed method is sand bag tamped detonation at the Landfill. The proposed method and location will prevent the spread of contamination at Camp Bonneville, limit the amount of handling and transport required, and ensure that items are free of energetic materials prior to disposition. This activity will incorporate joint inspection of the final waste material with the Army prior to disposition offsite.

4.3 DESCRIPTION OF LANDFILL EXCAVATION

Following completion of MEC/MC removal activities, excavation of the former landfill will begin. All landfilled material and associated soil contaminated above MTCA Method B soil cleanup levels will be excavted and removed. In the unlikely event that landfill debris extends into the saturated zone it will be removed. The limits of the material and soil to be excavated (i.e., above the MTCA method B soil cleanup levels) will be determined through a combination of visual inspection and confirmation sampling. In the unlikely event that the excavation extends to the water table and the results of the confirmation sampling still exceed MTCA Method B cleanup levels for soil, the sampling results will be discussed with DOE and additional excavation or some form of treatment may be considered.

The excavated material will be visually sorted into three classifications (landfill debris, obviously stained or contaminated soil, and visually uncontaminated landfill soil) before loading it for transport to the stockpile area. After transportation to the stockpile area, the material will be further sorted and profiled for appropriate disposal.

UXO personnel will remain onsite during all excavation and sorting activities following the MEC/MC removal phase to provide MEC/MC avoidance. All construction equipment used on the cleanup action will be decontaminated before being removed from Camp Bonneville.

4.4 ALTERNATIVES CONSIDERED AND JUSTIFICATION OF THE SELECTED ACTION

Alternatives for this Interim Cleanup Action were not evaluated. The February 2003 DOE EO requiring the cleanup of the Site stipulates that the interim cleanup shall be to excavate and dispose of materials and contaminated soil from the Site.

5. IMPLEMENTATION OF INTERIM ACTION ORDNANCE SUPPORT ACTIVITIES

This section of the CAWP provides a safe and efficient methodology for removal of potential MEC and related MC in the soils that are scheduled for removal at the Landfill.

5.1 OVERVIEW

This methodology has been developed to protect the workers performing site preparation tasks (brush clearance, road improvements, etc.), MEC screening/removal, and landfill soil/debris removal. The procedures and guidelines presented in this section of the CAWP should be used in conjunction with the Site-Specific Health and Safety Plan (HASP) for Remedial Action Ordnance Support Operations, included in the overall HASP.

This section of the CAWP contains procedures and guidelines for the following ordnance-related activities:

- Mobilization/demobilization;
- Conventional survey of the Landfill work area, establishment of corners and boundaries;
- Surface MEC/MC clearance/brush removal;
- Geophysical survey to verify size of work area;
- Tiered excavation of MEC/MC contaminated soils (using mag and dig techniques);
- Geophysical survey to identify deep anomalies;
- Excavation of geophysical anomalies;
- MEC avoidance for landfill excavation and other intrusive activities;
- Screening of soils excavated from the Landfill for MEC/MC removal;
- Disposal of MEC/MC (as appropriate) by detonation; and
- Inspection and disposal of MD and scrap

In addition, this portion of the CAWP provides a description of staffing, equipment, and quality control for ordnance-related activities. Effective integration of qualified UXO staff, appropriate equipment, and proper implementation of technically sound procedures is essential for safe, efficient MEC/MC removal from the Landfill.

The procedures and guidelines presented in this section of the CAWP have been developed based upon several important decision criteria including the following:

- The known history of the Landfill;
- The known history of Camp Bonneville;
- The munitions that are known to have been destroyed at the Landfill;
- The munitions that are known to have been used, stored, or disposed of at Camp Bonneville; and
- The experience and training of senior level UXO staff who have performed numerous ordnance removal projects at similar sites.

Section 2.1.2 contains a discussion of the ordnance potentially present in the Landfill. Based on the information available, the 155 mm projectile has been selected as the MPM for most of the planned activities at the Site. Two of the planned activities will be performed on soils that will have already been subjected to rigorous MEC removal procedures. For these two tasks, the MPM has been identified as a 20mm projectile. The MPM s and associated exclusion zones are discussed in more detail in Section 5.1.3.

The historical data available suggest that CWM is not present at the Landfill; however, CAIS were utilized at Camp Bonneville and there is a remote chance that these items were disposed of at the Landfill. If any indications of CWM are observed at the Landfill, or if suspect items are found, all work at the Landfill will immediately be terminated and all personnel will promptly evacuate from the site. The Senior Unexploded Ordnance Supervisor (SUXOS) will immediately notify the Army caretaker staff on site at Camp Bonneville and the Army representative at Fort Lewis. Work will not be re-initiated until it can be demonstrated that it is safe to do so and authorization is received from the Project Manager for MEC Operations (PMM) and the SUXOS.

5.1.1 Personnel Qualifications, Roles and Responsibilities

All Tetra Tech employees and subcontractors conducting MEC-related activities on this project are expected to maintain vigilance at all times to ensure that the work is conducted in a safe and efficient manner. They are also required to follow Tetra Tech's general safe work rules as discussed in the company's Corporate Environmental Health and Safety Program Manual, as well as the provisions of the site-specific HASP.

Tetra Tech personnel will be assigned specific project roles and responsibilities to ensure that lines-of-authority, efficient communications, and well-defined work requirements and responsibilities are maintained during the project. These project roles and responsibilities, as well as the necessary qualifications for each key position, are described below.

5.1.1.1 *Project Manager – MEC Operations*

The PMM will be responsible for the management of all aspects of the MEC/MC avoidance and removal activities. The PMM will provide management of and direction to the UXO personnel assigned to the project site and will keep the Tetra Tech Construction Project Manager (PMC) informed of personnel requirements, schedule, and field execution issues requiring resolution. The PMM is also responsible for ensuring that all needed resources are provided for UXO personnel.

The PMM will be required to have experience with all aspects of project management including planning, scheduling, logistics, development of work plans and reports, and billing. In addition, the PMM will have the following qualifications:

- Successful completion of the Tetra Tech Project Management 100 training course;
- Successful completion of the Tetra Tech Project Management 200 training course;
- Successful completion of the Tetra Tech Loss Control training course;
- Current Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training; and
- Previous experience with ordnance projects.

5.1.1.2 *Senior UXO Supervisor*

The SUXOS assigned to the project will direct MEC operations. This individual will be responsible for proper implementation of the field procedures outlined in the CAWP and the safety provisions of the HASP. He/she will have ultimate authority to stop work if MEC hazards above and beyond those outlined in the plans are encountered. The SUXOS will oversee all aspects of daily ordnance operations at the site and will work with the PMM to ensure safe, efficient, effective implementation of the Plans. This individual is responsible for tracking labor hours and equipment usage and preparing daily reports documenting MEC activities at the site.

The SUXOS will be a highly qualified UXO Technician III with 15 years of experience in the management of ordnance operations. The qualifications for a UXO Technician III are presented in Section 5.1.1.6. In addition, the SUXOS for this project will have the following qualifications:

- Demonstrated ability to plan, coordinate and supervise all on-site MEC activities;
- Demonstrated ability to supervise multiple UXO teams engaged in MEC activities, such as reconnaissance, surveying, vegetation clearance, location of surface MEC, excavation of subsurface MEC, classification of MEC, transportation and storage of MEC and explosives, and disposal of MEC by open burning or open detonation;
- Previous experience with soil screening operations for MEC removal;

- Previous experience in the development and implementation of site-specific UXO training programs; and
- Previous experience with onsite disposal of MEC/MC.

5.1.1.3 *UXO Safety Officer*

The UXO Safety Officer (UXOSO) assigned to the site will assist the SUXOS with implementation of the Site-Specific HASP and will be responsible for the observations, audits, and inspections needed to ensure that site operations are being conducted in a safe and prudent manner. The UXOSO will present daily safety briefings designed to increase awareness of site-specific hazards and the procedures in place to minimize them.

The UXOSO will be a highly qualified UXO Technician III with extensive experience in the management of ordnance operations. The qualifications for a UXO Technician III are presented in Section 5.1.1.6. In addition, the UXOSO for this project will have the following qualifications:

- Successful completion of the Tetra Tech corporate Environmental Safety Supervisor training (or other approved training);
- Successful completion of the Tetra Tech corporate Loss Control Course (or other approved training);
- Demonstrated ability to implement the approved UXO and explosives safety program in compliance with all Department of Defense (DoD), federal, state and local regulations;
- Demonstrated ability to analyze MEC operational risks, hazards and safety requirements; ensure compliance with all site-specific safety requirements for MEC operations; and, enforce personnel limits and safety exclusion zones for UXO operations; and
- Previous experience with OE/UXO transportation, storage and destruction.

5.1.1.4 *UXO Quality Control Officer*

The UXO Quality Control Officer (UXOQC) assigned to the Site will assist the SUXOS with implementation of the Quality Control (QC) measures specific to the ordnance operations onsite and will be responsible for the observations, audits, and inspections needed to ensure that site operations are being conducted in a manner consistent with the quality objectives for the project. The UXOQC will oversee equipment calibration, including daily function tests for metal detectors, and will participate in the inspection and certification process for MC found during excavation operations at the Landfill. The UXOQC role for this project will be filled by the UXOSO. This individual will perform both the health and safety related duties and the QC functions.

The UXOQC will be a highly qualified UXO Technician III with extensive experience in the management of ordnance operations. The qualifications for a UXO Technician III are presented in Section 5.1.1.6. In addition, the UXOSO for this project will have the following qualifications:

- Successful completion of the U.S. Army Corps of Engineers Construction Quality Management for Contractors training course, or other approved training or appropriate certification such as American Society of Quality certification as a QC Auditor, a QC Engineer, a QC Manager, or a QC Technician; and
- Demonstrated ability to fully implement the contractor's QC plans; conduct QC inspections of all MEC/MC operations for compliance with established procedures; and direct and approve all corrective actions to ensure all MEC operations comply with contractual requirements.

5.1.1.5 *UXO Team Leaders*

UXO Team Leaders assigned to the project will direct the daily activities of their individual teams. They will be responsible for ensuring that all required daily preparation tasks are performed, including equipment function testing. The team leaders are also responsible for clearly defining daily tasks assigned to the team and recording any required field data. The UXO Team Leaders will be qualified at the UXO Technician III level. The qualifications for a UXO Technician III are presented in Section 5.1.1.6. No additional, site-specific qualifications are required for this project.

5.1.1.6 *UXO Team Members*

UXO team members will be responsible for carrying out MEC operations in accordance with the instructions received from their respective team leaders. These individuals will operate metal detectors, perform visual observation for MEC items, and conduct intrusive investigation of subsurface anomalies identified using the metal detectors. UXO Team members are typically qualified at the Technician I or Technician II level; however, they may also be qualified at the UXO Technician III level. The minimum requirements for each technician level are specified below.

UXO Technician I

A UXO Technician I in the employ of Tetra Tech will be a graduate of one of the schools/ courses listed below, or any other DoD-certified equivalent school/course.

1. Explosive Ordnance Disposal (EOD) Assistants Course, Redstone Arsenal, AL
2. EOD Assistants Course, Eglin Air Force Base, FL
3. International UXO Training Program, Texas A&M University

A UXO Technician I can advance to the UXO Technician II level after 5 years of combined active duty military EOD and private sector UXO experience. This individual assists fully qualified UXO personnel (level II and above) in conducting reconnaissance and classification of MEC items; identifying all types of munitions; locating surface and subsurface MEC using locator equipment; performing excavation of subsurface MEC; transporting MEC and demolition materials, and preparation of electric and non-electric firing systems for destruction of MEC.

UXO Technician II

A UXO Technician II in the employ of Tetra Tech will be a graduate of one of the schools/courses listed below, or a UXO Technician I with at least 5 years combined military and private sector UXO experience.

1. U.S. Naval Explosive Ordnance Disposal School, Eglin Air Force Base, FL (formerly located at Indian Head, MD)
2. U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MDEOD Assistants Course, Redstone Arsenal, AL

This individual must be able to perform all the functions of a UXO Technician I. In addition, he/she must be able to properly store MEC material, identify fuzes, determine fuze condition, and operate navigation and location equipment.

UXO Technician III

A UXO Technician III in the employ of Tetra Tech will be a graduate of one of the schools/courses listed below, and will have at least 10 years combined military and private sector UXO experience.

1. U.S. Naval Explosive Ordnance Disposal School, Eglin Air Force Base, FL (formerly located at Indian Head, MD)
2. U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MDEOD Assistants Course, Redstone Arsenal, AL

This individual must have experience in the direction of MEC operations and the supervision of other personnel. He/she must be able to perform all the functions specified for the Technician I and II. In addition, this individual must be able to supervise on-site disposal of MEC; prepare explosive storage plans, administrative reports, and Standard Operating Procedures (SOPs) for MEC operations; perform MEC risk hazard analysis; conduct daily safety briefings; and supervise all onsite MEC operations.

5.1.1.7 *Geophysical Team Members*

The geophysical staff for the project will consist of a Geophysics Task Manager (GTM), Geophysics Field Lead (GFL), a data manager/QC technician, geophysical data acquisition/survey specialists, data processors/interpreters, and Geographic Information System (GIS) specialists. All of these individuals will have a background, as appropriate, in science, engineering, and computer science, or will be trained in the specific use of the instrumentation employed. The GTM and GFL will have training and experience in positioning equipment operation, maintenance, and supporting software.

5.1.2 Equipment

Several types of electronic instruments will be used during the MEC-related activities, including two types of metal detectors. This section provides a brief description of the features and operational principles of the major instrumentation for the MEC work, including the rationale for selecting the equipment.

White Spectrum XLT Metal Detector

The White Spectrum XLT is a hand-held metal detector. This instrument, which is known as a very low frequency (VLF) detector, has a single transmitter coil and a single receiver coil located in the instrument head. Electronic current is driven through the transmitter coil to create an electromagnetic field. The direction of the current flow is reversed several thousand times every second. When the current flows in a given direction, a magnetic field is produced with the polarity pointing into the ground. When the current direction is reversed, the polarity points out of the ground. This pulsing magnetic field induces a current in any metallic or conductive objects within range of the detector. This induced current has a polarity that flows against (in the opposite direction from) the field generated by the detector. The receiver coil in the metal detector is configured, so that almost all of the current that would normally flow from the transmitter coil to the receiver coil is cancelled out. However, since the current created by conductive objects in the ground flows in the opposite direction, it is not cancelled out; it is received and amplified by the detector.

The current produced by metallic objects in the ground exhibits a phase shift from the original current. This shift is different for various metals and can be used to differentiate between magnetic soils and buried objects constructed from different types of metals. This discrimination between metallic objects and iron-bearing soils, together with the limited range of the detector (approximately 12 inches) that prevents interference from metal objects deep within the soil horizon, makes the White Spectrum detector ideal for the tiered soil clearance and removal planned at the Landfill. The signal generated by near-surface metal objects will not be distorted or masked by metal objects deeper in the Landfill, and iron-bearing soils can be differentiated from true target objects.

Geonics EM-61 High-Sensitivity Metal Detector

The second metal detector selected for use at the Landfill is the Geonics EM-61 time-domain, electromagnetic, high-sensitivity metal detector. This detector uses two 1-meter square coils oriented one above the other. These two coaxial coils measure the residual magnetic field generated by conductive and/or magnetic materials. The EM-61 is designed to measure the residual magnetic field at a time when the response from conductive and/or magnetic objects is maximized, compared to the response from most earth materials (magnetic soils or rock). The use of two receiver coils also makes it possible to simply differentiate shallow versus deeper objects. An additional benefit of the specific design of the EM-61 system is that it permits a more focused observation of the subsurface in areas of cultural interference (e.g., utilities, landfill debris), as well as areas characterized by a high spatial density of subsurface objects. This is due both to the mechanical design and the operational parameters of the instrument, as well as to the inherent nature of active electromagnetic fields, which diminish in magnitude at a much higher rate than other sensor technologies such as magnetometers. The range of the EM-61 (can detect an isolated 55 gallon drum at approximately 3 meters bgs) coupled with the capacity of the instrument to provide relatively detailed data, makes it well suited for screening deeper landfill soils once the high-density metallic debris is removed from the upper soil horizon.

Location/Navigation Equipment

The third major component of the instrumentation for the MEC operations is a location/navigation system. The most likely choice for this system is the Leica Series 1100 RTS; however, alternative systems may be used, based on specific site conditions and needs. The Leica Series 1100 RTS consists of a laser-based total station survey instrument (transmitter), prism (receiver), and RCS 100 remote control. The transmitter is positioned over a ground position point of known location, and an x-y-z Cartesian coordinate system is defined by occupying an additional known ground position with the receiver prism. The RCS 100 remote control handheld unit allows one operator to control the RTS instrument from distances of several thousand feet away via wireless protocol. The receiver prism is mounted on a Tetra Tech doghouse centered over the EM-61. The RTS automatically tracks the prism at distances of several thousand feet to an accuracy of approximately 1 inch. Position data for the receiver prism are updated at a rate of 3-4 Hz and stored on a PCMCIA card located on the robotic total station. The RTS will fulfill all of the location/navigation needs for the project and will function well at the Landfill, despite the tall trees surrounding the area. Differential global positioning systems (DGPSs) may not be functional at the Site due to poor satellite signal recovery caused by the tall trees. However, these and other location/navigation systems may be used as appropriate for specific project tasks. A precision construction laser or other similar device may be used to simplify grade checking during excavation.

5.1.3 Establishment of Exclusion Zones Based on the MPM

The exclusion zones (EZs) for all ordnance-related activities at the Site will be based on the Department of Defense Explosive Safety Board, *Technical Paper 16*, Revision 1, 1 December 2003, Table B-1 (DDESB 2003) and the U.S. Army Corps of Engineers HNC-ED-CS-98-7, *Use of*

Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions (USACE, 1998). Two types of ordnance-based EZs are applicable to the work at the Landfill. The first type of EZ is based on a hazardous fragmentation distance (1/600 rule) for accidental detonations. This type of EZ is generally applicable to field activities that could result in an accidental detonation including both MEC operations and construction activities. The second type of EZ that will be used at the Landfill is based on the maximum fragmentation distance used to determine fragmentation distances for intentional detonations. This type of EZ will be used during MEC/MC disposal operations. At the request of the US Army Technical Center for Explosive Safety (USATCES), the maximum fragmentation distance has also been selected for soil screening operations even though this operation would result in an accidental detonation.

The size of the EZ for accidental detonation will be different for various tasks. For most activities, this EZ will be based on the 155 mm projectile as the MPM. Although AIM missiles, which have a greater overall NEW than the 155mm projectiles, were disposed of at Landfill 4, the 155mm projectile has a greater fragmentation distance due to its charge to weight ratio. Based on this greater fragmentation distance, the 155mm projectile was selected as the MPM. Since it is not known what type of 155 mm projectile was previously found at the Landfill, the Projectile, 155-Millimeter: HE, M107 was selected as the MPM. This projectile was chosen from among the various types used at Camp Bonneville based on the greater hazard associated with this type of projectile. The Net Explosive Weight (NEW) for this projectile is 14.5 pounds. Using Table 5-1, which is a reproduction of a portion of Table B-1 in the referenced DDESB publication, this EZ will be set at 447 feet.

The size of the EZ for accidental detonation during activities preceded by comprehensive MEC removal will be based on a 20 mm projectile as the MPM. It is not known what type of 20 mm ammunition was disposed of at the Landfill: however; anecdotal information obtained from the Portland National Air Guard (PANG), indicates that 20mm ammunition disposed of by that organization at Camp Bonneville was PGU 27 TPT ammunition. This particular round is a target practice munition that has no explosive filler and poses little hazard to site workers. Since no specific records are available to ensure that this was the only type of 20mm ammunition destroyed at the landfill, a 20mm round containing a high-average amount of filler has been selected as the MPM for soil excavation following mag & dig operations and for soil screening to provide adequate protection for site workers. The 20mm M56A4 contains 9 grams of filler, which is at the high end of the net explosive weight (NEW) for a majority of the 20mm projectiles made in the United States. In accordance with Table 5-1, EZ for this type of 20 mm projectile will be set at either 200 feet (hazardous fragmentation distance) or 318 feet (maximum fragmentation distance) depending on the type of operation being conducted. This smaller MPM is appropriate for selected activities because a 20 mm projectile is the largest munition that can reasonably escape detection during the planned MEC removal activities preceding these tasks. EZs for accidental detonation during specific MEC-related project activities are presented in Section 5.2 of the CAWP and in the SOPs for specific tasks (see Appendix A).

The size of the EZ for disposal operations at the Landfill will be based on guidance provided in HNC-ED-CS-98-7. This document specifies the use of withdrawal distances based upon sandbag throw distances for specific types of MEC or 210 feet, whichever is greater. The EZ for disposal based upon the USACE document is greatly reduced over the maximum fragmentation distance required in the DDESB document. This reduction is based on the use of specific thicknesses of sandbags to contain the blast and fragmentation caused by the intentional detonation of MEC items with specific NEWs. A copy of the guidance is included in Appendix A, SOP 5 (MEC/MC Disposal).

5.2 FIELD METHODOLOGY

This section contains a detailed description of the equipment and procedures that will be used to conduct ordnance operations in support of interim remedial actions at the Landfill. These procedures and any associated requirements will apply to all Tetra Tech personnel, subcontract personnel, and any other personnel having a role in these operations or working onsite concurrently. The ordnance operations portion of the project work has been incorporated expressly to protect site workers during interim remedial actions. Strict adherence to the procedures and requirements for this work will be necessary to ensure that the goal of this project element is met.

Table 5-1

High Explosive Bombs And Projectiles

Munition	Explosive Weight (lbs.) *(Kg)*	Diameter (in) *(mm)*	Maximum Fragment Weight (lbs) *(g)*	Fragment Initial Velocity (ft/s) *(m/s)*	Maximum Fragment Range		Hazardous Fragment Distance (ft.) *(m)*
					Horizontal (ft) *(m)*	Vertical (ft) (m)	
GP Bomb (Mk XIII Mod 2)	511.00 *231.784*	17.70 *449.58*	0.9848 *446.6954*	8,239 *2,511.2*	3,617 *1,102.5*	2,859 *871.4*	734 *223.7*
Bomb MK 83	445.00 *201.848*	13.94 *354.08*	0.8923 *404.7433*	6,074 *1,851.4*	3,288 *1,002.2*	2,568 *782.7*	813 *247.8*
Bomb M64A1	274.00 *124.284*	14.20 *360.68*	0.0221 *10.0334*	8,116 *2,473.8*	2,501 *762.3*	1,991 *606.9*	680 *207.3*
Bomb MK 82 Mod 1	192.00 *87.089*	10.75 *273.05*	0.8963 *406.5300*	5,193 *1,582.8*	3,177 *968.3*	2,462 *750.4*	688 *209.7*
16" Mk 14 Projectile	153.57 *69.658*	16.00 *406.40*	15.4582 *7,011.6759*	2,426 *739.4*	5,639 *1,718.8*	3,995 *1,217.7*	550 *167.6*
250 lb Bomb M 57 TNT	129.02 *58.522*	10.36 *263.14*	0.2894 *131.2572*	8,293 *2,527.7*	2,032 *619.4*	1,625 *495.3*	534 *162.8*
250 lb Bomb M 57 Amatol	113.72 *51.582*	10.36 *263.14*	0.3396 *154.0578*	6,365 *1,940.1*	2,497 *761.1*	1,965 *598.9*	492 *150.0*
Bomb MK 81 Mod 1	100.00 *45.359*	9.00 *228.60*	0.5167 *234.3631*	6,674 *2,034.2*	2,856 *870.5*	2,247 *684.9*	583 *177.7*
100 lb Bomb GP Mk 1	65.00 *29.483*	7.90 *200.66*	0.1013 *45.9487*	9,005 *2,744.7*	1,863 *567.8*	1,491 *454.5*	200 *61.0*
100 lb Bomb AN M30A1	62.00 *28.123*	8.20 *208.28*	0.0997 *45.2229*	8,414 *2,564.6*	1,831 *558.1*	1,467 *447.1*	483 *147.2*
155 mm M795	28.80 *13.063*	6.10 *155.00*	0.5620 *254.9176*	4,635 *1,412.7*	2,699 *822.7*	2,078 *633.4*	436 *132.9*
155 mm M107	15.45 *7.007*	6.10 *155.00*	0.6482 *294.0227*	3,426 *1,044.2*	2,577 *785.5*	1,983 *604.4*	447 *136.2*
155 mm Mk I	15.17 *6.881*	6.10 *155.00*	0.7681 *348.4206*	4,032 *1,229.0*	2,842 *866.2*	2,169 *661.1*	395 *120.4*
6" Trench Mortar	13.00 *5.897*	6.00 *152.40*	0.1142 *51.7891*	3,939 *1,200.6*	2,631 *801.9*	2,008 *612.0*	366 *111.6*
75 mm Mk I	1.64 *0.744*	2.95 *75.00*	0.1531 *69.4288*	3,479 *1,060.4*	1,702 *518.8*	1,298 *395.6*	238 *72.5*
75 mm M48	1.47 *0.667*	2.95 *75.00*	0.1530 *69.4109*	3,471 *1,058.0*	1,701 *518.5*	1,297 *395.3*	234 *71.3*
81 mm M43	1.29 *0.585*	3.19 *81.00*	0.0573 *25.9907*	4,933 *1,503.6*	1,395 *425.2*	1,097 *334.4*	230 *70.1*
90 mm HEAT M371 & M431	1.20 *0.544*	3.54 *90.00*	0.1240 *56.2452*	3,075 *937.3*	1,546 *471.2*	1,170 *356.6*	209 *63.7*
60 mm M49A5	0.79 *0.358*	2.36 *60.00*	0.0166 *7.5296*	6,290 *1,917.2*	1,013 *308.8*	806 *245.7*	200 *61.0*
2.36 " Rocket (Case Only)	0.50 *0.227*	2.36 *59.94*	0.0010 *0.4695*	8,888 *2,709.1*	809 645 *246.6*	200 *196.6*	*61.0*
60 mm M49A3	0.42 *0.191*	2.36 *60.00*	0.0237 *10.7387*	5,114 *1,558.7*	1,080 *329.2*	856 *260.9*	200 *61.0*
40 mm MK2	0.187 *0.085*	1.57 *40.00*	0.0331 *14.9959*	3,605 *1,098.8*	1,095 *333.8*	847 *258.2*	200 *61.0*
3"/50 AP Mk 29	0.14 *0.064*	3.00 *76.20*	0.4299 *195.0079*	1,058 *322.5*	1,595 *486.2*	1,117 *340.5*	200 *61.0*
37 mm MK II	0.053 *0.024*	1.46 *37.00*	0.0245 *11.1130*	3,302 *1,006.4*	980 *299*	754 *230*	200 *61*
20 mm M56A4	0.026 *0.012*	0.79 *20.00*	0.0006 *0.2642*	3,183 *970.2*	318 *96.9*	251 *76.5*	200 *61.0*